

Brief Communication: Stature Estimation in Extinct Aónikenk and the Myth of Patagonian Gigantism

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ABSTRACT The Aónikenk were a hunter-gatherer group that inhabited the southern extreme of Patagonia at European Contact and became extinct at the end of the 19th century. The myth of Patagonian gigantism developed around these aborigines from early Spanish explorer accounts. In this study, the postcranial remains belonging to the Aónikenk (Patagonia) and the Selk'nam (Tierra del Fuego) preserved at the Instituto de la Patagonia (UMAG, Chile) have been measured, using standard metrics. Different stature estimations for these groups have been generated, by using the different regression formulae available. Aónikenk male stature appears to be between 174 and 178 cm on average, whereas the Selk'nam are considerably shorter. In addition, stature estimations from Spanish populations dating to the contact period have been compiled for comparison. While it can be concluded that the Aónikenk probably presented the highest stature values of all Meso- and South American populations, it is suggested that the perception of their gigantism could be partially attributed to the real difference in stature (probably more than 10 cm) between these aborigines and contemporaneous Europeans. *Am J Phys Anthropol* 105:545–551, 1998. © 1998 Wiley-Liss, Inc.

In the Americas, stature varies considerably with latitude, the tallest aboriginal populations being those from Canada and Patagonia (Johnston and Schell, 1979). In South America, Salzano and Callegari-Jacques (1988) reviewed the stature of 43 different tribes, finding male mean values ranging from 157.0 cm in the northwest to 161.3 cm in the central-southeast of the continent. Unfortunately, as the Patagonian tribes became extinct at the end of the 19th century under the pressure of European colonization, the stature of living populations is unavailable.

The explorer Ferdinand Magellan and his men were probably the first Europeans who established contact with the Patagonians in 1520. Their chronicler Antonio Pigafetta was impressed by the extremely tall stature of the Patagonian aborigines, as was Juan de

Areyzaga, who made contact with the South Patagonians 6 years later. These first European accounts, some of them clearly fantastic, gave rise to the American myth of Patagonian gigantism. During the 18th and 19th centuries ethnographical expeditions obtained progressively more accurate measurements of Patagonians. Martinic (1995) compiled the most relevant ethnographic information about the South Patagonians, and inferred estimations of their stature, taking into consideration the units of measurement (English and Spanish feet and inches) used in the post-contact period by

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TABLE 1. *Aónikenk* stature accounts made by different European ethnographical explorers¹

Explorer account	Date	Mean male height	Maximum male height
Bougainville	1767	—	1.88
Wallis	1767	1.78–1.83	2.00
Córdoba	1787	1.82–1.96	2.03
Morrell	1826	1.88–1.90	1.93
King	1826	1.78–1.80	1.87
Darwin	1834	1.80	—
Schythe	1853–64	1.76	1.83
Schmid	1858–64	1.77	1.89
Cunningham	1867–68	1.83	2.08
Musters	1869–70	1.78	1.93
Lista	1877	1.85	1.86
Ibar	1877	1.83	1.92

¹ Adapted from Martinic (1995); units are meters.

the different explorers (Table 1). However, this information is now untestable and was probably biased towards the tallest individuals, those who greatly impressed the Europeans.

At the beginning of the 20th century Verneau (1903) studied skeletal remains of presumed Patagonians in some detail. However, some methodological aspects, such as the uncertain origin of the samples, the lack of description of the measuring techniques employed and the use of the Manouvrier tables, make these data of limited scientific value. The absence of reliable skeletal samples has contributed to the almost complete abandonment of the anthropological study of Patagonian stature during this century.

However, recent archaeological digs have unearthed a sample of skeletal remains attributed to the extinct Aónikenk, a southern Patagonian group that lived in historic times between the Magellan Straits and the Santa Cruz river (Martinic, 1995). This group has sometimes been designated as “South Tehuelches,” although they called themselves Aónikenk, which means “people of the south.” Although the sample size available is still small, it permits reliable estimations of stature for the populations from the South of Patagonia where, according to ethnological expeditions, gigantism was more pronounced.

We measured the long bones from the Aónikenk archaeological sample to obtain through regression equations an approximation to the living stature of this Patagonian

tribe. In addition, we compiled information from several late medieval Spanish skeletal samples to evaluate the possible stature of the Spanish explorers at the contact period.

MATERIALS AND METHODS

All the postcranial bones recovered from Aónikenk burial sites and preserved at the Instituto de la Patagonia (Punta Arenas, Chile) were measured following the classical measurements described by Martin and Saller (1957). The measurements considered are: humerus maximum length, humerus total length, humerus minimum circumference, radius maximum length, radius minimum circumference, ulna maximum length, ulna minimum circumference, clavicle maximum length, clavicle midshaft circumference, femur maximum length, femur physiological length, femur midshaft circumference, tibia total length, tibia minimum circumference, fibula maximum length and fibula minimum circumference. In addition, the available sample excavated in Tierra del Fuego and attributed to the Selk'nam (Ona) group was studied for comparison.

The total sample comprised 14 Aónikenk and seven Selk'nam adult individuals. The skeletons were sexed by standard anthropological procedures (Ferembach et al., 1980). Pelvic remains were present in most cases and thus sex attribution is consistent, except for four fragmentary individuals that were included in the male sample. Only one Aónikenk and one Selk'nam were diagnosed as female, thus statistical treatment was undertaken with the male sample.

Stature reconstruction of individuals from past populations has been based mainly on regression equations generated from long bone length. However, there are different regression formulae obtained from different skeletal samples (Manouvrier, 1893; Pearson, 1899; Olivier and Tissier, 1975; Trotter and Gleser, 1952, 1958; Sciulli et al., 1990; Sciulli and Giesen, 1993; Feldesman and Fountain, 1996; among others), and some of these methods yield more accurate figures than others. For instance, by comparing different methods with anatomical data, Formicola (1993) and Formicola and Franceschi

(1996) concluded that Pearson (1899) and Olivier et al. (1978) use formulae which are better stature estimators than those from Trotter and Gleser (1952), whose estimating formula show inconsistencies in the measurement techniques used for the tibia sample (Jantz, 1992; Jantz et al., 1994). Also, regression equations have usually been obtained from living populations and thus it is debatable whether a given prehistoric sample can be comparable from a genetic and environmental point of view to those populations. In the case of native Patagonians an additional difficulty arises since no equations from living populations are available at present. Consequently, many authors have emphasized the difficulties in reconstructing stature from skeletal remains (Brothwell, 1981; Formicola, 1983; Demoulin, 1986; Krogman and Iscan, 1986; Rösing, 1988; Ubelaker, 1989).

Probably one of the best estimates of living stature is the anatomical method, proposed by Fully (1956) and based on the sum of all the skeletal components of height (Olivier, 1960; El Najjar and McWilliams, 1978; Rösing, 1988). However, the anatomical method can only be correctly applied when relatively complete skeletons are available, since the skull, the vertebral column and the lower limb bones are needed. Most of the Aónikenk archaeological samples are represented by some postcranial long bones, thus rendering impossible the correct application of the anatomical method in the present study.

We have taken into consideration the classical formulae of Trotter and Gleser (1958) for Mongoloid samples, and also the more recent formulae of Feldesman and Fountain (1996) for Mongoloid "race," generated from the ratio between femoral length and stature, compiled from all the available literature. Also the formulae of Genovés (1967) for Mesoamericans, and Sciulli and Giesen's (1993) for prehistoric Native Americans of Ohio have been used. A point for future discussion might be whether regression equations from living Mongoloid populations are appropriate for all Amerindian stature estimation, and if the formulae from

a particular group can be applied in other populations.

Lastly, we used *t*-tests to determine the significance of differences in mean femur physiological lengths between Aónikenk and four medieval Spanish skeletal samples.

RESULTS

The mean individual values averaged from both left and right sides were computed, extracting from them population values for the Aónikenk and the Selk'nam (Table 2). Our results show that the Aónikenk consistently present larger dimensions of all bones, although this must be viewed cautiously due to the low sample size of the Selk'nam group.

It is interesting to note that within the Mongoloid group, the largest femoral length reported by Feldesman and Fountain (1996) is 45.60 cm, and that Sciulli et al. (1993) found that the mean of maximum femur length is 47.71 cm in terminal Late Archaic populations of Ohio. In the Aónikenk sample, the mean femur length is 47.11 cm, being consequently among the largest ever described for a Mongoloid or Amerind human group.

From these data, we tried to estimate stature by using different formulae. The stature estimations obtained for the Aónikenk using the methods of Trotter and Gleser (1958) and Feldesman and Fountain (1996) are displayed in Table 3. In the case of Trotter and Gleser (1958), formulae generated from the lower limb bones are the most reliable, since they combine larger sample sizes and lower statistical error values. The most reliable results from the formulae of Trotter and Gleser (1958) show stature values that range from 174 to 178 cm for the male Aónikenk, that of the TG2 formula (176 cm) being probably the most accurate. A similar figure has been obtained with the Feldesman and Fountain (1996) formulae. Although the mean stature could have been around 176 cm, some of the individuals from our sample show values up to 180 cm, thus confirming the existence of notably tall individuals in this group. Our results agree with the ethnographic accounts (cited in Martinic, 1995) of J. Schythe (1853 to 1864), T.

TABLE 2. Mean values and postcranial indices for the Aónikenk and Selk'nam male skeletal samples

	Aónikenk			Selk'nam		
	N	Mean	S.D.	N	Mean	S.D.
Humerus						
(1) Maximum length	10	324.40	3.07	2	312.25	5.25
(2) Total length	10	321.35	2.99	2	305.75	7.75
(7) Minimum circumference	10	68.65	1.44	3	60.50	3.04
Robustness index	10	21.19	0.54	2	20.17	0.62
Radius						
(1) Maximum length	7	257.71	4.88	4	240.38	8.75
(3) Minimum circumference	6	45.83	1.42	4	40.13	2.40
Robustness index	6	17.82	0.47	4	16.72	0.93
Ulna						
(1) Maximum length	5	285.70	3.12	4	257.25	9.15
(3) Minimum circumference	5	39.50	1.64	4	36.63	1.46
Robustness index	5	13.82	0.51	4	14.27	0.61
Clavicle						
(1) Maximum length	4	176.00	3.83	2	162.00	7.00
(6) Midshaft circumference	4	40.25	2.06	2	35.00	5.00
Robustness index	4	22.90	1.28	2	21.51	2.16
Femur						
(1) Maximum length	9	471.11	7.91	5	427.40	6.17
(2) Physiological length	9	466.67	7.84	4	425.38	6.72
(8) Midshaft circumference	8	97.50	2.48	5	89.10	1.48
Robustness index	8	20.93	0.31	4	21.16	0.07
Tibia						
(1) Total length	6	396.08	7.28	5	349.70	8.77
(10b) Minimum circumference	4	85.25	2.85	5	81.00	2.97
Robustness index	4	21.55	0.18	5	23.21	1.01
Fibula						
(1) Maximum length	1	408.00	—	1	372.00	—
(4a) Minimum circumference	1	44.00	—	1	37.00	—
Robustness index	1	10.78	—	1	9.95	—

N, sample size; Mean, group mean; S.D., standard deviations; units are mm. Numbers in parentheses correspond to the coding of Martin and Saller, 1957.

Schmid (1858 to 1864) and G. Musters (1869 to 1870), which were probably the most realistic according to Martinic (1995). It can be concluded that in Meso- and South America the Aónikenk were most probably the tallest human group at the contact period. This results resemble the stature of Subarctic Algonquian Indians in North America (Szathmáry, 1984).

In addition, the Genovés (1967) and Scullli and Giesen (1993) formulae have been applied. The results from both methods are similar: stature values ranging between 168 and 170 cm. These results are certainly lower than those obtained from the Trotter and Gleser (1958) and Feldesman and Fountain (1996) methods. The formulae for stature calculation must be chosen according to which population has the same long bone to stature proportions as the group studied, and this is not available for the Aónikenk, but the mean femur length suggests the

TABLE 3. Stature values obtained for the male Aónikenk samples through Trotter and Gleser (TG) and Feldesman and Fountain formulae

	Error (±)	Aónikenk stature
Trotter and Gleser (1958) formulae		
TG1 = 1.22 (F1 + P1) + 70.24	3.18	177.49
TG2 = 1.22 (F1 + T1) + 70.37	3.24	176.17
TG3 = 2.40 (P1) + 80.56	3.24	178.48
TG4 = 2.39 (T1) + 81.45	3.27	176.11
TG5 = 2.15 (F1) + 72.57	3.80	173.86
TG6 = 1.68 (H1 + U1) + 71.18	4.14	173.68
TG7 = 1.67 (H1 + R1) + 74.83	4.16	172.04
TG8 = 2.68 (H1) + 83.19	4.25	170.13
TG9 = 3.54 (R1) + 82.00	4.60	173.23
TG10 = 3.48 (U1) + 77.45	4.66	176.87
Feldesman and Fountain (1996) formulae		
Stature = 2.84 (F1) + 40.17		173.97
Ratio femur length-stature (Feldesman and Fountain, 1996)		
Stature = (F1 * 100) / 26.47		177.98

F1, femur maximum length; P1, fibula maximum length; T1, tibia total length; H1, humerus maximum length; U1, ulna maximum length; R1, radius maximum length; units are cm.

TABLE 4. Stature estimations and femur length values from late medieval Spanish skeletal samples

	Male stature estimation (Pearson regression method)					Femur physiological length				
	N	Mean	S.D.	Dating	Reference	N	Mean	S.D.	t-test	Probability
Catalonia	57	166.2	4.72	9th–16th A.D.	Vives (1987)	103	447.9	25.87	2.157	0.0166*
La Olmeda (Palencia)	72	163.7	4.79	7th–13th A.D.	Hernández et al. (1991)	34	434.6	20.00	4.609	0.0000*
Sta. Maria de Hito (Cantabria)	28	168.6	5.46	6th–12th A.D.	Galera and Garralda (1992)	28	457.6	22.29	1.168	0.1254
Palacios de la Sierra (Burgos)	22	165.3	5.15	10th–13th A.D.	Souich et al. (1990)	21	439.2	21.58	3.593	0.0006*
Villanueva de la Soportilla (Burgos)	26	164.4	3.23	9th–12th A.D.	Souich et al. (1991)					
Spain (in vivo)	6072	163.5	—	19th A.D.	Olóriz (1896)					

* Significant at the 0.05 probability level.

N, sample size; Mean, group mean (cm); S.D., standard deviation. *t*-test values are generated by comparing Aónikenk mean femur length with each Spanish sample.

Aónikenk were very tall. Finally, there is the argument that a stature nearing 176 cm fits better with reported data by ethnographic measures of 19th century (see Martinic, 1995). Since we have no data about the long bone to stature proportions in the Aónikenk, these results can only suggest a range of stature probably between 174 and 178 cm.

Applying the Trotter and Gleser (1958) formulae to the Selk'nam, stature values obtained (data not shown) are clearly lower than those of the Aónikenk, although we note that the sample size is clearly insufficient. The Selk'nam were probably between 160 and 173 cm, a value that fits with that found by Gusinde (1939) in 24 male living individuals (average stature of 172.9 cm, ranging from 163.1 to 180.9 cm). The differences between Selk'nam and Aónikenk could be due to relationships of Selk'nam with the other (Yámana and Kawéskar) Fuegian groups (Hernández et al., 1997).

The femoral length of the Aónikenk sample differed significantly from the femoral lengths of three of the four medieval Spanish samples (Table 4).

DISCUSSION

Stature has been interpreted as a variable with a strong genetic component (heritability around 0.80), primarily related to climatic adaptation (Schneider, 1975; Crognier, 1981). However, it may have been notably modified at both individual and population level by environmental factors, especially nutrition and health status. Thus, the inter-

pretation of the tall Aónikenk stature still remains a matter of debate. We believe, however, that it could reflect an ancestral adaptation of this group to the harsh Patagonian environment and to a nomadic way of life. A similar explanation was provided by Hall and Hall (1995) for geographic variation in body size of native people of North America. The findings suggest that the responses to climatic stresses follow ecological rules.

Stature estimations for the Spanish samples are displayed in Table 4. For these populations we used Pearson regression equations, which according to Formicola (1993), fit better with anatomical data, at least in European samples. The perception of Patagonian gigantism was probably accentuated by the fact that the stature of the Spanish people at the contact period was fairly modest compared to that of the contemporaneous Aónikenk. Average male Spanish stature was around 165 cm at the pre-contact period. These values have remained unchanged until the 20th century, as data from Olóriz (1896), taken in living individuals, confirm. Although the regression methods used in both human groups are not directly comparable, the Aónikenk may have been perhaps 10 cm taller on average than the Spanish explorers. Table 4 shows that the femoral bones from the Spanish samples are always shorter than those from the Aónikenk [physiological length as defined by Martin and Saller (1957)]. The differences are statistically significant in most cases

(Table 4). These data reinforce the idea that the gigantism myth arose mainly from the notable difference in stature between Spanish explorers and Patagonian aborigines.

Our results confirm the tall stature of the Aónikenk group. Although the existence of Patagonian "gigantism" can be discarded, their remarkable stature places these aborigines among the tallest American populations.

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